A Collaborative Effort to Collect Biological, Chemical and Geological Data to Quantify the Interrelationships Which Influence Stream Impairment

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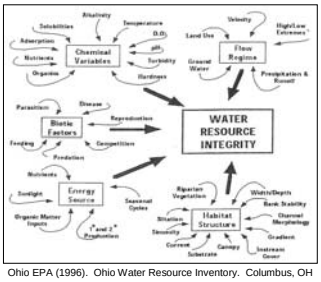
The Clean Water Act requires that the water quality in the Nations lakes and streams be assessed. The States use various methods for rating water quality, but the most common system involves rating the health and wellbeing of organisms living within the water, such as macroinvertebrates (insect larvae, crawfish, etc.) or fish. These health conditions are influenced by many factors including available habitat, food and oxygen, water flow and biology, as illustrated in this diagram from the Ohio EPA.



Ohio EPA (1996). Ohio Water Resource Inventory. Columbus, OH

Collecting data on all of these different physical and biological properties is very time consuming and expensive, therefore, the EPA has been working to develop methods which can be used regionally.

This research project has evolved to provide an interdisciplinary study of the factors which impair streams with three main goals:

1) Improve the understanding of the relationships between the factors involved in defining water quality and biological integrity.
2) Develop, or test, procedures for effectively collecting the data needed to assess the condition of a stream.
3) Establish a baseline data set for future comparison.

Thirty-five subwatersheds were selected in the Little Miami River Watershed in Southwestern Ohio for study. Five connected research studies are being or have been carried out to collect this data either with varying levels of intensity or with different time scales:

1) Annual EMAP measurements
2) Quarterly water quality sampling
3) Automated water quality data collectors (Sondes)
4) Remote sensing of land-use
5) Geomorphology

Environmental Monitoring and Assessment Program (EMAP)

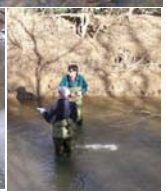
EMAP provided a measure of the overall wellbeing of the system by measuring the following metrics each summer:

1) Fish Population and Diversity
2) Primary Productivity (periphyton)
3) Macroinvertebrates
4) Physical Habitat
5) Chemical Variables

EMAP sampling provides snap-shot of the current condition of the stream by providing detailed information on many of the factors which cause impairment. EMAP is a data collection method developed by EPA for the States to use in standardizing the water quality data reported.

Quarterly Sampling

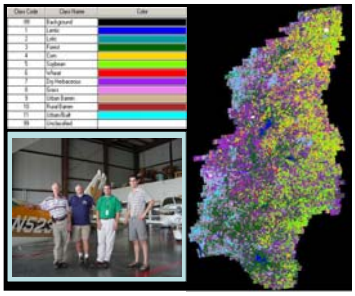
A limited version of the EMAP sampling procedure was performed every three months. This included water samples for water chemistry, periphyton and a limited measure of the physical habitat. By sampling more often seasonal variation can be considered in assessing impairment and the effect of flow can be incorporated in the data set.



Automated Data Collection

Sondes were deployed for 72-hour sampling periods, or longer, throughout the year. This instrument measures the following parameters every 15 minutes for the entire deployment providing information on both the short-term variation in the values, the variation over the diurnal cycle (day-night) as primary productivity responds to light levels and because of the more extensive deployment schedule seasonal variation.

1) Dissolved Oxygen
2) Turbidity
3) Chlorophyll
4) pH
5) Conductivity
6) Depth/Temperature



Remote Sensing of Land-Use

An aircraft equipped with a multi-spectral camera, which takes pictures outside the visible range, photographed the entire watershed. By comparing the same image at different wavelengths the land-use can be determined in great detail, even to the point of differentiating between agricultural crops, i.e. corn vs. soy beans. Land-use influences the availability of nutrients and the hydrology (flow regime).

Geomorphology

The geological properties which make up the habitat structure and flow regime have been measure more intensely than in EMAP to provide a means of classifying and rating the stability of the stream. Understanding the geomorphology of a streams allows for prediction of risk of impairment from natural and human-induced changes to the flow regime.

Conclusion

By collecting data in the same location over varying time intervals with a range of sampling intensities, it is expected that we will be able to gain a better understanding of the interrelationships between the various factors which determine water quality. This understanding may lead to improved data collection methods to be used in protecting the Nation's waters.

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